the plotted observations from the graph of the law are to be considered. For instance, when the equation is written

$$y_1 - ax_1 - b = \delta',$$

the divergence δ′ is measured along the ordinate; but when it is written

$$cy_1 - x_1 - d = \delta'',$$

the divergence δ″ is measured in the direction of the abscissa. Now if the divergencies were measured at right angles to the graph, and the sum of the squares were made a minimum, the graph would be the principal axis of inertia of the system of points. This line passes through the intersection of the other pair of lines, and gives a smaller sum of squares than any other line. When the number of points is very great, all three lines become sensibly coincident.

We may conclude, then, that when the observations are numerous and fairly concordant, the method of least squares, applied in the manner commonly taught, will give a practically unique result. But if in any particular case there be any doubt on this point, by reason of the number of observations being small, or the discrepancies between the observations being very great, it would appear to be desirable to find both the lines corresponding to the values of *a*, *b* and *a′*, *b′*, given above, in order to test the question. In the event of the difference between the pairs of constants obtained not being negligeable, the proper line to be made use of, in preference to either of the two others found as above, would seem to be the principal axis of inertia.

A. F. RAVENSHEAR.

102 Croxted Road, West Dulwich, S.E.

The Collection of Material for the Study of "Species."

STRANGELY enough, while the publication of "The Origin of Species" and the research which has been carried on since Darwin wrote his epoch-making work have completely revolutionised the morphologist's conception of what is a "species," nearly all the "systematic" work which is published even at the present day, especially in those branches of biological science where the amateur collector exerts most influence, is based upon the principles founded by Linnæus. These principles, while they were perfectly logical in pre-Darwinian days, are now, however, quite obsolete and out of harmony with the current state of biological knowledge. With a view to bringing scientific practice more into accord with scientific theory, a paper to which I listened at a recent meeting of the Linnæan Society suggested a reform in the present system of species nomenclature. Since, however, the great majority of those who describe "species" are unfortunately not in a position to realise how great indeed is the necessity of some such reform, it will probably not obtain immediate support from the systematists. The average "systematist" still holds the pre-Darwinian view of "species"; and, as the great bulk of the material at his disposal in public and private collections is of little value for the proper study of taxonomy, he quite fails to see how absolutely untenable his position really is. He does not realise how utterly impossible it is in certain groups to assign limits to the variability of "species," and it will never occur to him that two specimens superficially alike in all respects may quite possibly have been evolved along entirely different paths.

It is not my intention here to enter into a discussion as to whether a system of provisional names, such as is suggested by Mr. Bernard, might not be of distinct advantage in at least some branches of zoological inquiry; what I do wish to call attention to now is the necessity, if any decided advance is to be made in the study of taxonomy, for a sweeping change in the present system of collecting material, and in its representation in collections. The following remarks bear particularly upon the case of the mollusca, of which group I have personally most knowledge, but they are, of course, more or less applicable to other branches.

The taxonomist requires as a basis for his investigations to know as exactly as may be the range of variation which those forms in which he is interested experience at the different stations over which they occur. This knowledge is obviously most satisfactorily acquired by personal observation on the spot; but, as this is seldom practicable, the student is in general forced to rely upon material collected by others. Unless this material has been properly collected, the conclusions based upon it are likely to be erroneous; and most of the material available to the student of such groups as the Mollusca is eminently unsatisfactory. Apparently the aim of many conchologists is to represent (?) in their collections the greatest possible quantity of "species," each by a certain definite number—usually three—of "fine specimens." These may be as unlike the ordinary examples of the form as can be; and, whether they are localised or not is of little account, so long as they be fine. If a larger or more brilliantly coloured specimen is obtainable it replaces one of the mystic three.

Large Series necessary.—Little can be known about a species until large series have been examined; yet a collector or museum curator almost invariably prefers a "new species" to a specimen which might lead to a clearer understanding of others already in the collection. Again, in most museums two or three shells, for instance, are considered to amply represent a species. When one has only a few examples under examination it is a fairly simple matter to assign these to so-called species; but the task becomes very different when one comes to deal with a large series, particularly if the specimens are from different localities. In all groups the range of specific variability is very much greater than will be admitted by those who confine their attention solely to museum specimens: in the case of the marine Mollusca, it is often quite easy to select from a large gathering of a single species two or more series which will readily pass as distinct species if the intermediate forms are suppressed. In the past, many "species" have been thus formed; and, if rumour speaks truly, this has sometimes been done quite knowingly, the connecting forms having been carefully destroyed; though more generally it has arisen inadvertently through the study of insufficient material. Again, a museum series, in addition to demonstrating the range of variation of a form, should also illustrate its life-history; but only too frequently an immature individual is regarded by the collector as a "bad specimen" and thrown away as valueless.

Exact Localities.—The most important consideration in a collection is that every specimen shall be accurately localised, and the more minutely the exact locality has been recorded the more valuable will the specimen be for study. At the present day, perhaps, few collectors are satisfied with such records as "Australia" or "America," but such scarcely less vague ones as "S. Africa," "W. Indies," &c., are to be commonly met with; and specimens with inexact localities, or without any record at all, abound in our museums. One unsatisfactory feature about specimens purchased from dealers is that there is a temptation for the dealer to suppress the true origin of his specimens.

Those whose knowledge of species has been derived mainly from museum specimens seldom realise how greatly these species often vary in relation to their environment. Thus, in the case of the marine Mollusca, specimens obtained from the sandy portions of a shore will frequently differ perceptibly from others of the same species collected on the neighbouring rocks or mud. By keeping the series from different stations distinct, the collector will often be surprised at the considerable local variation which his specimens will manifest.

Fossil and Recent Forms.—The treatment of palæontology as a distinct science is one of the greatest obstacles in the way of a proper appreciation of the problems of taxonomy. In most museums, as in our own National collection, the fossil forms of a group are widely removed from their recent allies; and the not unnatural result is that writers on existing species of, say, the Mollusca, seldom make even the slightest reference to fossil members of the group. A true knowledge of the relationships of the living members of any group *can* only be attainable by the study of those forms which have preceded them in the process of evolution; and this research will be greatly simplified when recent and fossil forms can be examined side by side. The comparison of recent specimens with the closely related subfossil ones from the same locality and elsewhere is of most particular importance, but is as yet seldom possible.

The Condition of Specimens.—Among conchologists, and in this respect they are almost the only sinners, insufficient attention is generally paid to the condition of the specimens. The collector of shells too often prefers to gather up the miscellaneous débris of a "shell beach" rather than search for living examples, and unfortunately he is in the habit of founding "species" upon material so obtained. A very large percentage of Molluscan species has been based upon single, dead and unlocalised specimens: what wonder that so many of their names are absolutely worthless?

"*Faking*" *Specimens.*—Any interference with the natural

© 1901 Nature Publishing Group

appearance of a specimen is to be most strongly deprecated, unless, indeed, this has been deliberately undertaken for the express purpose of demonstrating some particular structural feature; yet many collectors are in the habit of making their specimens "look pretty." The conchologist removes the periostracum from his shells, treats them with acid or oil, and conceals any imperfection by aid of a file; the entomologist is said to be not above patching a damaged insect with parts taken from another specimen (not necessarily of the same species); and corals are occasionally provided with artificial bases of plaster of Paris.

The practice in vogue in many museums of mounting small specimens upon tablets is an exceedingly bad one, since it greatly restricts any critical examination; moreover, the specimens are liable to be injured by the cement used.

Collecting a Representative Series of Specimens.—As has been pointed out, scientific research necessitates the examination of large series of specimens exactly representing the form as it occurs at the particular station where the specimens were collected. The field naturalist will most readily ensure that a series shall conform to this condition by collecting every specimen of the form in question which is observed during a certain period of work—five minutes, an hour, a month, according to its abundance and variability. And, in order that small local variations may be rendered evident, the area over which the series is collected must be a small one. If now the whole gathering thus obtained is kept *intact* and unmixed with specimens collected on other occasions or at different stations, it may safely be regarded as fairly representing the species as it occurred at that particular time and place; and it will form a satisfactory basis for comparison with similar series gathered elsewhere and at other seasons. It will probably be urged that this system of collecting is impracticable, as it will entail greater cabinet space. Granted that it may necessitate the provision of more storage room, but is not the usefulness of a collection the only excuse for its formation? And if more space is required it must be provided. However, this objection is not nearly so serious as might be imagined; it is by no means necessary or even desirable that enormous series of specimens should be displayed for exhibition in museum cases or cabinets; all that is required is that they should be stored in such a way as to be easily accessible when wanted for study. Thus in most cabinets much space is occupied by cotton-wool which could readily be filled with specimens without in the least adding to the bulk of the collection. In any case, whatever difficulties may be encountered they will have to be overcome, as only when large series of carefully localised specimens from numerous stations are gathered together in our museums and private collections will it be possible for any really scientific taxonomic work to be accomplished. Until this material is available it is useless to argue over rules of nomenclature and such like, as no satisfactory answer can yet be given to the fundamental question, "What is a species?"

S. PACE.

Variations of Atmospheric Electricity.

I ENCLOSE a photograph of the tracings, recording the atmospheric electricity disturbances from January 4 to February 15 inclusive. The records are obtained in the following manner: Two antennæ are used, one vertical 20 metres in length, its lower extremity connected to coherer. The other, 47 metres long, consisting of an ascending vertical portion of 20 metres, also connected below with same pole of coherer, a horizontal portion of 7 metres, and a descending vertical portion of 20 metres, the whole being the shape of an inverted U, going up one side of house, across the top and down the other side. These two antennæ are carefully insulated. The other pole of coherer is connected to earth, in this case to the bottom of a deep well. The coherer closes the circuit of a relay, which in its turn closes the circuit of two electro-magnets, one of which draws up the style and so records a stroke on the revolving drum; the other sets a clockwork apparatus in movement which strikes coherer and so decoheres. The receiver is situated on a hill, overlooking the neighbouring country.

The disturbances seem at times to recur about the same time on successive days, or sometimes after an interval of a day or two. For instance, the first two on the 4th and the first two on the 9th seem to have some connection. Again, the second pair on the 9th seem identical with the first pair on the 10th.

Taking the central group on the 9th, 10th, 12th, 14th, it might be subdivided into two groups, commencing on the 9th with two in each group, reaching its maximum on the 10th, five and seven, and on the 12th reduced to one in each group, finally, on the 14th, only one remaining in the stronger group, that is the one with a maximum of seven.

On February 13 there was one disturbance, on February 14 two, the first of which was at identically the same time as the one of the previous day. It would be interesting to compare the records of several receivers and see how far-reaching these disturbances are, or whether they are purely local phenomena. For this purpose two more receiving stations are shortly to be fitted up in this department. During the period covered by these records there have been no visible or audible signs of thunderstorms, and on many occasions the sky was cloudless, barometer high, thermometer low—28° F. to 36° F.—during the last eight days of February, when there could have been no storms within several hundred miles.

E. PELLEW.

Bellevue, Laroin, Pau, Basses Pyrénées, France.

The Selborne Yew-tree.

GILBERT WHITE, in his "Antiquities of Selborne," Chap. v. (Chandos Classics Edition) mentions a male yew growing in the churchyard. He believed it to be some centuries old and states its girth as 23 ft. This afternoon I have, with Mr. Lewis Eynon, remeasured the trunk and find it to be 25 ft. 6 in. The stem of this magnificent tree is squat and rather bulging, and as White mentions its girth as something extraordinary, it is to be presumed that his measurement was made at the point of maximum diameter—about four feet from the ground. This is the height at which our figure was obtained, and we used a steel tape taken right round without regarding irregularities of surface. The increase in girth will be seen to correspond to a radial growth of 4·7 in. in the 120 years or so since White's time. I know not whether recent measurements of this tree have been published, but the fact seems worthy of record.

F. SOUTHERDEN.

75 Barry Road, Dulwich, S.E. March 16.

INJURIOUS CONSTITUENTS IN POTABLE SPIRITS.

AN interesting communication is just to hand, by Sir Lauder Brunton and Dr. Tunnicliffe, upon "Certain apparently injurious constituents of potable spirits." Its appearance now is certainly opportune, since, whatever else we may be interested in, alcoholic beverages are certainly attracting a deal of public attention at the present time. It is further, if not a relief, certainly a change, to learn that something else in alcoholic drinks besides arsenic and selenium may be the cause of mischief, and their removal advantageous. Our mentation just now is rather apt to be over-arsenicated; moreover, from the point of the consumer, the impurities discussed by these workers certainly seem to have one important advantage over arsenic, in that they can be completely removed—that is, removed to the satisfaction of the chemist as well as to that of the pharmacologist.

The subject of whiskey, with which the above monograph is concerned almost entirely, has not received very much attention at the hands of chemists, pharmacologists or dietetic experts, since the publication, in 1891, of the report of the select Committee on British and Foreign Spirits. This Committee directed itself mainly to the question whether compulsory bonding, as practised in Canada, should be adopted in this country, and also whether any restrictions should be placed upon blending, as by, for instance, limiting the name whiskey to the product made from malt, or malt and grain, in a so-called pot-still. The result of the Committee, so far as legislation was concerned, was nil. In the course of the inquiry, however, many interesting pharmacological facts came out, and the present work must be looked upon as a continuation of what may be termed the pharmacology of whiskey. Readers who are interested in the subject are strongly recommended to consult the Blue Book, which contains a mass of most interesting and important information.

© 1901 Nature Publishing Group